COVER PAGE
Improving Teacher Quality
Higher Education Grants Program
Project Year 2015-2016
S.C. Commission on Higher Education

1. Project Title: **Understanding Mathematics by Design**
2. Institution: **Clemson University**
3. High-Need LEA(s): **Abbeville County; Greenwood 51**
4. Other Collaborating Organizations: n/a

5a. Project Director Name & Title **Dr. Calvin L. Williams** **Associate Professor, Mathematical Sciences;** **Director, Center of Excellence in Mathematics and Sciences Education** *Mailing Address* **Clemson University** **Box 340975, 0-323 Martin Hall** **Clemson, South Carolina 29634-0975**	Phone Number: **(864) 656-5241** E-Mail: **calvinw@clemson.edu** FAX: **(654) 656-5230** Signature Date Calvin L. Williams 10/12/14
5b. Project Co-Director Name & Title **Dr. Nicole Bannister** **Assistant Professor, Mathematics Education and Mathematical Sciences** *Mailing Address* **MAT Program, University Center Suite D-6** **225 S. Pleasantburg Drive** **Greenville, SC 29607**	Phone Number: **(864) 250-6709** E-Mail: **nbannis@clemson.edu** FAX: **(654) 656-5230** Signature Date Nicole Bannister (Sinwell) 10-9-14
6. Chief Executive Officer **Dr. Larry Dooley** **Vice President for Research** *Mailing Address* **Clemson University** **104 Riggs Hall** **Clemson, South Carolina 29634**	Phone Number: **864-656-3200** E-Mail: **dooley@clemson.edu** FAX: **864-656-4466** Signature Date 10-14-14

Signing for

7. Proposed Funding a. ITQ (CHE): **$150,000** b. Institution: **$0** c. Cooperating LEA: **$0** d. Other: **$0** e. TOTAL: **$150,000**	9. Partnership Representatives/Signatures *College/School of Education* Name **Dr. Nicole Bannister** Signature Nicole Bannister *Arts and Sciences* Name **Dr. Calvin L. Williams** Signature Calvin L. Williams *Local Education Agency: Abbeville County* Name **Dr. Jonathan Phipps** Signature *Local Education Agency: Greenwood #51* Name **Dr. Fay Sprouse** Signature Fay Sprouse
8. Estimated Number of Project Participants: 25	

Abstract

Middle school mathematics often serves as an educational gatekeeper for adolescents—especially those living in poverty in districts identified as high-needs school districts (Moses, 2001; NRC, 1989; Schoenfeld, 1988, 2002). Given the content knowledge demands of teaching middle school mathematics and the increased accountability measures on teachers to apprentice adolescents into the disciplinary habits of mind espoused by the Common Core State Standards, higher education must partner with school districts to bridge the gap between the learning needs of students and the knowledge and practice of practitioners. Therefore, in order to increase student mathematical learning and achievement, the *Understanding Mathematics by Design* project intends to build the content knowledge and pedagogical content knowledge of rural middle school mathematics teachers through a targeted programmatic intervention between January 2015 and August 2016. Through the use of monthly video club meetings and an annual summer institute, teachers will experience the thinking of their discipline, deconstruct their own mathematical practices, and design appropriate scaffolds and instructional responses for adolescents. By targeting middle-grades mathematics (5-10) teachers serving rural communities, we situate our project in the context of a critical gatekeeping subject and reach out to teachers in the midst of a critical transition in education policy.

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Demonstrated Need for the Program

Abbeville County and Greenwood 51 school districts have been identified as high-needs LEAs based on alarmingly high rates of children living in poverty in those districts and a corresponding low rate of highly qualified teachers. The *Understanding Mathematics by Design* project targets middle-grades math teachers in these districts because they teach a high stakes content area that consistently plays a gatekeeping role for students (Moses, 2001; NRC, 1989; Schoenfeld, 1988, 2002). As Schoenfeld (2002) explained, "course work in mathematics has traditionally been a gateway to technological literacy and to higher education" (p. 13). However, for the large numbers of students who fail or leave math course work, math has instead served as a gatekeeper from higher education and economic access (Moses, 2001; Schoenfeld, 2002). As an NRC report declared, "More than any other subject, mathematics filters students out of programs leading to scientific and professional careers […] Mathematics is the worst curricular villain in driving students to failure in school" (1989, p. 7). Making matters worse, a disproportionate number of poor and minority students compose this group, meaning working-class students and students of color are marginalized in their mathematics classes more than their peers. As civil rights leader and Algebra Project founder Bob Moses (2001) argued,

> Today…the most urgent social issue affecting poor people and people of color is economic access…[which] depend crucially on math and science literacy. I believe that the absence of math literacy in urban and rural communities throughout this country is an issue as urgent as the lack of Black voters in Mississippi was in 1961. (p. 5)

The *Understanding Mathematics by Design* project is an innovative and compassionate response to evidence of these nationwide trends in our local communities in South Carolina.

South Carolina's transition to and away from the Common Core State Standards for Mathematics (CCSSM) presents added complexity and challenge to these prior dilemmas, as a greater depth and breadth of content has been pushed down to earlier grades. By targeting middle-grades mathematics (5-10) teachers serving rural communities, we situate our project in the context of a critical gatekeeping subject and reach out to teachers in the midst of a critical transition in education policy.

Given these needs, our prior work with middle grades teachers in these districts focused on expanding teachers' content knowledge alongside well-documented habits-of-mind (NCTM, 2014; Horn, 2012; Levasseur & Cuoco, 2009) and principles of learning (Bransford et al., 2000). While we documented significant gains in teacher learning from our prior programs (see Table 1 for evidence), we still have much work to do. There is a great deal of content that teachers still need to learn.

Project Year & Content Focus	**Evaluator Comments by Dr. John K. Luedeman**
2012-2014 Geometry	"The pre-test demonstrated that the participants were not knowledgeable on questions 4, 5, 7, and 10 while they mostly knew the material covered by questions 3 and 9 and many lacked knowledge about the other four questions. A paired difference t-test demonstrated learning on all questions and on the overall scores for the test."
2013-2014 Probability & Statistics	"The pre-test demonstrated that the participants did not already know the content of Questions 1, 2, 5, 6, 7, 8, 9, and 10. The test scores were analyzed using a paired t-test. At the 0.0005 level of significance, the participants demonstrated mastery of questions 1, 2, 6, 7, 8, 9, 10 and the entire test material. At a 0.001 level of significance, learning was demonstrated on question 5. While on question 3, learning was demonstrated at the 0.025 level of significance. The only item not demonstrating any learning was question 4 which most of the participants got correct on the pre-test. **Conclusion:** Both the original workshop and the extension can be classified as successes. The instructors worked well together. The participants were excited about the knowledge gained both in content and pedagogy. The paired t-test demonstrated that the participants learned."

Table 1: Evidence of teacher learning in previous project years.

With these results in mind, we conducted a needs assessment with teachers and school district leaders in these high-needs LEAs to determine the direction for our future shared work. The needs assessment revealed teachers need help learning more algebra, geometry, connections between standards, using technology, and helping their students learn to be better problem solvers in collaborative classroom environments. We learned from our meetings with school district leaders their teachers need help making sense of what their mathematics students know and do not know, and then responding to the learning needs of individual students. School district leaders specifically asked for programs to (1) empower teachers to make sense of student data in ways that help teachers help individual students, and also (2) align their curriculum, instruction, and assessments in response to these new standards.

Based on these needs and established partnerships, our project team proposes to continue the meeting structures from our previous projects, as our summer institute and video club programs have been popular with teachers. However, the focus of our program activities will change to meet these revised goals. To meet teachers' needs, we will focus all of our future work on making sense of the mathematics central to the middle grades South Carolina mathematics standards designed to replace CCSSM. We will complement teachers' content development with research-based, high-quality activities that help them align their curriculum, instruction, and assessment practices.

Purpose and Objectives

The overarching goal of the *Understanding Mathematics by Design* project is to increase student mathematical knowledge and achievement in middle grades South Carolina classrooms. We aim to meet this goal by fostering innovative approaches to teaching and learning

mathematics with rural middle grades teachers in Abbeville County and Greenwood 51 (Ware Shoals) school districts, both of which have been identified as high-needs LEAs.

Our primary purpose, therefore, is to increase middle grades mathematics teachers' understanding of mathematics. A second and fundamentally related goal is to ensure teachers have the support and skills they need to create classrooms environments where students can engage in mathematics specified by modern standards. Thus, the objectives for this project are to (1) increase teachers' knowledge of content proximal and relevant to the middle grades mathematics standards in South Carolina, and (2) increase teachers' pedagogical content knowledge of mathematics needed to align and implement curriculum, instruction, and assessments that align with modern standards (NCTM, 2000, 2014; Wiggins & McTighe, 2005). These objectives will be measured at each phase of the project using content focused pre- and post-assessment data.

Our overarching strategy to meeting our two objectives, increasing teachers' content knowledge and increasing pedagogical content knowledge, involves supporting teacher learning in context of professional communities of practice (Kanold, 2012; Wenger, 1998). Linda Darling-Hammond (2014) asserted a primary strategy for U.S. schools to improve the working conditions for teachers and increase student achievement is to reorganize schools so collaboration time for teachers is the norm rather than the exception. In addition to evidence this investment produces better outcomes for teachers and students (Darling-Hammond, 2014; Featherstone et. al, 2011; Horn, 2012; Nasir et. al, 2014), there is empirical evidence from researchers in the U.S. a positive relationship exists between teachers' participation in strong teacher communities and equitable student achievement (Boaler & Staples, 2008; Gutiérrez,

1996, 2012; Horn, 2005; Lee & Smith, 1996; McLaughlin & Talbert, 2001). As such, we propose work situated under the umbrella of professional learning communities.

Previous programmatic evaluations and facilitator reflections on programmatic effectiveness confirmed three overarching assumptions about the content knowledge and pedagogical content knowledge of participating middle school math teachers in years 2012-2013 and 2013-2014 of our project. First, participating teachers have often perceived mathematical content as settled and to be disseminated or explained to students instead of viewing mathematics as processes involving sophisticated disciplinary reasoning, ways of knowing, and practices (Horn, 2012; NCTM, 2014). As a result of both the Common Core State Standards and *Principles to Actions: Ensuring Mathematical Success for All* (NCTM, 2014), adolescents need teachers who apprentice them into mathematical practices and view mathematical content as incorporating key concepts, processes, and literate practices. Secondly, with this view of mathematical content and a need for teacher reconceptualizing of mathematical content to align with standards-based reforms, we also assume teachers need to experience the thinking of their discipline in order to apprentice students into mathematical practices and ways of problem solving (Horn, 2012; Levasseur & Cuoco, 2009). Finally, in additional to a need to reconceptualize mathematical content, mathematical teachers in our program also need to deepen understanding of pedagogical content knowledge. Therefore, with these assumptions, our programmatic design includes a three-phase process for developing teacher content knowledge and pedagogical content knowledge. During each video club meeting and during Summer Institutes, participating teachers will first experience the mathematical thinking (Phase One) before deconstructing their own mathematical practices (Phase Two) and then envisioning

additional pedagogical scaffolds to apprentice adolescents into the inquiry, reasoning, problem-solving and practices valued in the discipline of mathematics (Phase Three).

Description of Program Activities

The overarching goal of the *Understanding Mathematics by Design* project is to increase student mathematical knowledge and achievement in middle grades South Carolina classrooms. We aim to meet this goal by fostering innovative professional community-based approaches to teaching and learning mathematics with rural middle grades teachers in Abbeville County and Greenwood 51 (Ware Shoals). We propose a school year video club and summer institute programs to meet our partnering teachers' and districts' needs for making sense of the complex challenges created by more rigorous content standards and higher expectations for classroom performance. Based on the results of a needs assessment we conducted with teachers, the content focus of our work will address "big ideas" (Wiggins & McTighe, 2005) from South Carolina middle grades content standards related to algebra, geometry, and data analysis. In conjunction with this focus on content development, we will address our partnering districts' needs for teachers to make sense of data and align their curriculum, instruction and assessment practices through training in formative assessment techniques (Shell Center, 2013; Wiliam, 2011), backwards planning (Wiggins & McTighe, 2005), and the development and implementation of a teacher-led action research project (Sagor, 2012).

The following gives detail to each of our proposed activities:

I. Summer Institute: Clemson Mathematics Institute (CMI)

The purpose of the Clemson Mathematics Institute is to engage teachers in immersive experiences to increase their content knowledge related to the middle grades content standards and positively impact their knowledge about the mathematical practices standards. We model our

two-week long summer institute after the Park City Mathematics Institute/Institute for Advanced Study summer program, which has a long history of positively affecting teacher learning (IAS/PCMI, 2013). We base our program activities on three strands for teacher learning: "continuing to learn and do mathematics; analyzing and refining classroom practice; becoming resources to colleagues and the profession" (IAS/PCMI, 2013). The structure of our three-part day follow these strands, with focus on content development in the morning, work on the mathematical practices standards mid-day, and time for professional collaboration and action research project development in the afternoon. To be sure, our team views these three strands as inseparable and mutually influential, though narrowing in our learning goals helps our team zoom in on and bring attention to content, practices, and collaboration particulars.

We propose two 2-week summer institutes for summer 2015 and summer 2016, respectively. Following the structure of the IAS/PCMI model, the 2015 summer institute will focus on content immersion experiences (Curcio et. al, 2013) and training in formative assessment techniques (Shell Center, 2013; Wiliam, 2011), backwards planning (Wiggins & McTighe, 2005), and action research (Sagor, 2010). Clemson faculty will also support teacher development of action research plans, as well as collaboration time for teachers. The 2016 summer institute will have a similar focus, including content immersion experiences and refresher training in formative assessment techniques, backwards planning, and action research as needed. Clemson faculty will thoroughly debrief teachers' action research projects, and support teacher conference proposals and/or publishable practitioner manuscripts using the results of their projects.

II. Video Club

Video clubs provide teachers with the opportunity to develop both a shared language and norms for talking about their teaching practices and to engage in detailed analysis of classroom interactions (Sherin, 2003; Sherin & Han, 2004; Sherin & van Es, 2005). This professional development model promotes teachers opening their classroom doors to their colleagues for review (Lortie, 1975; Little, 2003) and tuning in to students' mathematical thinking (Ball, 1997; Sherin & Han, 2004), which are essential elements for improving teacher quality (NCTM, 2014). We propose monthly after-school video club meetings during the school year both to increase teachers' content knowledge and also to help teachers connect with our partnering districts' needs for teachers to make sense of data and align their curriculum, instruction and assessment practices. The video club meeting schedule will include:

- Gathering, check-in, and work on a mathematics task that will appear in a video of a mathematics classroom. Also work on a challenging, related task selected by a Clemson faculty member.
- Debriefing tasks using the following questions: What is the math in the task? What standards are addressed by these tasks? Where might students get confused?
- Watching a 5-7 video clip of students working on a mathematical task. Though some videos may be selected from published materials, the goal is to use video from participating teachers' classrooms. (Note: We have had enthusiastic support from teachers and have not experienced difficulty with getting teachers to volunteer to have their classrooms filmed for our previous two years of the project.)
- Debriefing the video using these questions: Using evidence from the video, what do students understand about the mathematics?

- Completing an exit survey reflecting on the video club meeting, which includes content assessment questions.

Superior facilitation and community-generated norms are essential for a successful video club. Some tried and true norms include the following: our conversations are confidential, ask genuine questions and avoid comments/judgments disguised as questions; stick to our goal of making sense of student thinking and avoid evaluative statements about the teacher; participate fully and be fully present in all parts of the meeting; and use respectful language when speaking about students and teachers. To be sure, teachers who volunteer to be filmed will be given a copy of the video to review and approve before the video meeting. This teacher will be asked to "set up" the video before it is shown and will be given first speaking rights after the video has been shown. In all cases, teachers will be encouraged but not required to have their classrooms filmed to participate in the video club, and any teacher who is filmed will be allowed to change their mind about showing his or her video after filming. Since the goal of the video review is to discuss student understanding, videos potentially embarrassing for students or teachers will not be shown. The video club meeting will be supported by all project faculty, with facilitation by a Clemson faculty member with five years of experience conducting every portion of the video club experience. A long-term goal is to gradually release the responsibility of video club meeting facilitation to teachers.

Our summer institute and video club program activities address the identified needs of our partnering districts and teachers by increasing the teachers' content knowledge in the most problematic strands in middle grades mathematics, as well as helping teaches make sense of student data and improve the quality of instruction. The program provides professional development activities to increase the subject matter knowledge and pedagogical content

knowledge of middle grades mathematics teachers. These professional development activities are sustained, intensive, classroom focused, and aligned with national, state, and local standards and mathematics curricula. These activities should result in a demonstrable and measurable improvement in teacher content knowledge alongside improvements in pedagogical content knowledge.

Participants

Participants in the *Understanding Mathematics by Design* project will be middle level mathematics teachers (5-10) employed in Abbeville County and Greenwood 51 school districts. Teachers will receive a formal invitation to participate in the project once the development team has been notified that the grant proposal has been funded. In this invitation, teachers will be made aware of the benefits for them: program materials, technology, books, stipends, continued professional development with faculty from Clemson University, a support system for implementing innovative instructional strategies, and the establishment of a professional network across our partnering districts.

Evaluation Plan

The objectives for this project are to increase teachers' content knowledge and pedagogical content knowledge of mathematics therefore increasing student mathematical knowledge and achievement. These objectives will be throughout the proposed eighteen-month educational program including each video club meeting and during each day of the Summer Institute. The principal investigators, with the aid of an external evaluator, will implement a comprehensive evaluation plan for our program in order to measure the impact of our educational program on teacher content knowledge and pedagogical content knowledge. The evaluation plan consists of components related to the two programmatic activities (video club meetings and summer

institutes). A rationale and detailed description for each evaluation component is found below.

1. Programmatic Pre-test and Post-test for Teachers

   Teachers will complete pre- and post- assessments at the beginning and end of the project year. These assessments will consist of a range of problem-solving activities that will be analyzed for initial and final content and pedagogical content proficiency. These pre- and post- assessments will allow the development team to analyze and observe any changes in teachers' content and pedagogical content knowledge that occurs during the course. The pre- and post- assessments will be identical and will be composed of two parts: one part will evaluate the extent of the participants' content knowledge, and the other part will assess the participants' pedagogical content knowledge. A needs assessment with district administrators and a preliminary focus group with participating teachers in the fall of 2014 will be used to determine specific topics for content knowledge and pedagogical content knowledge development.

2. Video Club Meeting Pre-test and Post-test for Teachers

   At the start of each video club meeting and prior to Phase One of the learning experience, teachers will take a pre-test measuring mathematical content knowledge. A post-test measuring areas of mathematical emphasis during the meeting will be administered prior to the conclusion of each video club meeting.

3. Video Club Meeting Artifacts

   In addition to summative feedback in the form of participant evaluations of courses and post-assessments and observations, the development team will implement formative assessments such as reflection journals and exit questionnaires after the video club meetings. These artifacts—including short written prompts, curricular designs, teacher collected student

learning artifacts, and teacher created documents to share during video club—will address the emphasized content or pedagogical content knowledge and provide evidence of teacher learning during Phase Two and Phase Three of video club meetings. These reflections will not only be an opportunity for participants to think meaningfully about their learning, but provide the development team with valuable, real-time feedback about participants' understandings about mathematics content and pedagogical content.

4. Video Club Meeting Transcriptions

   The video club meetings will be video taped. Teachers' conversations will produce valuable, real-time feedback about participants' understandings about core project ideas, growth in content knowledge and pedagogical content knowledge, and gaps in teacher content knowledge and pedagogical content knowledge.

5. Teachers' Evaluation of Summer Institute

   These evaluations will be done at the end of each day's summer institute session. The questions will be specific to the content knowledge and pedagogical content knowledge emphasis areas for the day, accompanied by a Likert-scale, and designed to provide quantitative and qualitative feedback on the course.

6. Focus Group with Participants

   This is one way to give participants an opportunity to discuss strengths of and suggestions for this educational program in an open, relaxed, and non-threatening environment. A focus group will be conducted during a video club meeting in May 2015, December 2015 and May 2016. The participants will also share instances of putting the ideas from the courses into practice in their classrooms. Our external evaluator, who will provide the Project Director with transcripts of the session, will conduct the focus group.

Key and Support Personnel

1. **Calvin L. Williams**, Ph.D. will be the Project Director for the *Understanding Mathematics by Design* project. Dr. Williams has an earned doctorate in Biometry from the Medical University of South Carolina. Dr. Williams is an Associate Professor of Mathematical Sciences at Clemson University and serves as the Director of the Center of Excellence in Mathematics and Science Education (CEMSE). His current duties involve teaching mathematics and serving as the coordinator of instruction for the mathematical sciences department. Dr. Williams will devote 5% of his time to this project. He will participate in course development and teaching activities (See Appendix A for Curriculum Vitae).
2. **Nicole Bannister**, Ph.D. will serve as the co-Project Director for this project. Dr. Bannister has an earned doctorate in Learning Sciences from the University of Washington with an emphasis in Mathematics Education and a Master of Science in Mathematical Sciences from Clemson University. Dr. Bannister is an assistant professor in Teacher Education, with focus on Mathematics Education. Her primary teaching duties involve teacher training courses for future middle grades mathematics teachers geared towards future secondary teachers, including their mathematics courses. Dr. Bannister will devote 10% of her time during the academic year to this project. She will participate in course development, teaching activities, classroom observations, and video club production (See Appendix B for Curriculum Vitae).
3. **Phil Wilder**, Ph.D. Dr. Wilder has an earned doctorate in Curriculum and Instruction from the University of Illinois at Urbana-Champaign. Dr. Wilder is an assistant professor at Clemson University in Teacher Education, with focus on disciplinary literacies. His current duties involve teaching disciplinary literacies courses to undergraduate and graduate students in numerous secondary school disciplines. Dr. Wilder will devote 5% of his time during the

academic year to this project. He will participate in course development, classroom observations, and teaching activities (See Appendix C for Curriculum Vitae).

4. **John K. Luedeman**, Ph.D. has an earned doctorate in Mathematics from the State University of New York at Buffalo. Dr. Luedeman served as a professor of mathematical sciences at Clemson University until his retirement in 2002. Dr. Luedeman has over three decades of experience working with professional development programs for teachers. Dr. Luedeman will serve as external evaluator for the *Understanding Mathematics by Design* project. (See Appendix D for Curriculum Vitae).
5. **Benjamin Sinwell**, M.Ed. Mr. Sinwell has an M.Ed. from Boston University in Mathematics Education and a B.A. from Vassar College in Biology. Mr. Sinwell is a mathematics teacher at Pendleton High School in Anderson District #4, has National Board Certification, and 13 years of teaching experience in public schools, including appointments at the Howard University Middle School for Science and Math in Washington, D.C. and Chelsea High School in Chelsea, MA. Mr. Sinwell served on the Editorial Panel for *The Mathematics Teacher* journal for four years and co-authored and co-taught the content course for the IAS/PCMI summer teacher program for six years. Mr. Sinwell now sits on the nominal and elections board for NCTM and presently leads content-related professional development for NCTM's teacher institutes nationwide. Mr. Sinwell will work closely with Dr. Williams and serve as the Master Teacher for the content immersion experiences for the 2016 summer institute. (See Appendix E for Curriculum Vitae).
6. **Clemson Ph.D. Student**. Given the importance and time demands of our evaluation plan and program activities, we will need a graduate student to help us with data collection, data storage, data coding, classroom video taping, and additional program preparation activities.

Appendix A

Calvin L. Williams,Ph.D., Associate Professor/Director
Center of Excellence in Mathematics and Sciences Education (CEMSE)
Department of Mathematical Sciences, Clemson University
Clemson, SC 29634-0975, Phone: (864) 656-5241, Fax: (864) 656-5230, calvinw@clemson.edu

Education:

College of Charleston, Dept. of Mathematics	Mathematics	Bachelors of Science, 1981
Medical University of South Carolina, Dept. of Biometry	Biometry	Doctor of Philosophy, 1987
Carnegie Mellon University, Dept. of Statistics		Postdoctoral Research, 1993-1994

Professional Experience:

8/04-present	Director, CEMSE*	Clemson University
	*Center for Excellence in Mathematics and Science Education	
8/02-8/04	Program Director	NSF Division of Undergraduate Education
6/94-5/95	Visiting Associate Professor	Carnegie Mellon University
8/93-present	Associate Professor	Clemson University
6/93-8/93	Visiting Assoc. Research Scholar	Stanford University
7/87-8/93	Assistant Professor	Clemson University

Research And Scholarly Interests
Training: Applications of statistical techniques to biological processes (biostatistics), statistical simulation, and development of statistical techniques for solving problems in categorical data analysis. **Current Practice**: ***Educational***: Development of programs and activities for access by teachers and students in the K-16 community. Developing and assessing teaching strategies for teaching and learning mathematics, specifically, Calculus. ***Technical***: Applications of statistical techniques to biological processes (biostatistics) through statistical simulation.

Sponsored Research (Partial List)

"Transitioning through Technology: Using Digital Learning Environments in Calculus as a Collaborative Model to Advance STEM Students through Four-year Institutions", Hewlett-Packard, Co-PI $280,000 in technology (May, 2009)

"Mathematics Partnering with Computer Science to Improve Calculus Instruction and Learning," National Science Foundation, PI, $415,203.00 ($137,016.00) (08/01/2008-07/31/2011).

"OrganicPad: A TabletPC Based Interactivity Tool for Organic Chemistry," National Science Foundation, Co-PI $311,740.00 ($103,913.00) (01/01/2008-12/31/2010).

"CU-STEP: Enhancing the Undergraduate Experience through Research and Curriculum Development," National Science Foundation, Co-PI, $1,138,830.00 ($204,989.00) (09/15/2005 - 08/31/2009).

"Building a Mathematical Learning Community," SC Commission on Higher Education, PI $125,000.00 ($12,500) (01/15/2006-03/15/2007).

Selected Peer-Reviewed Publications (partial list)
[1] DeVol, Timothy A., Gohres, Amy A. and Williams, C. L., "Application of classical versus bayesian statistical control charts to on-line radiological monitoring." Journal of Radioanalytical and Nuclear Chemistry (2009) DOI 10.1007/s10967-009-0255-8.
[2] Pargas, R., Cooper, M, Williams, C.L., and Bryfczynski, S. "OrganicPad: A TabletPC Based Interactivity Tool for Organic Chemistry" in Pen-Based Learning Technologies, 2007 PLT 2007 First International Workshop, pp. 1-6, May 2007.

[3] Williams, CL, ``Hyperprior Imprecision in Hierarchical Bayesian Modeling of Clustered Bernoulli Observations", InterStat 2003(with Ann-Janette Locke).
[4] Williams, CL, ``Smooth Estimation of the Reliability Function", Lifetime Data Analysis, 7, 413-433, (with KB Kulasekera, M. Coffin, and A. Manatunga) (2003).
[5] Williams, CL, ``An Adaptive Procedure for Goodness of fit Based on Sample Spacings", Communications in Statistics: Simulation and Computation, Volume 30, Issue 2, (with K. Alam) (2001).

Total Number of Graduate Students Advised and Postdoctoral Scholars Sponsored:
10 M.S. graduates, 1 Ph.D. graduate

Advisors and Collaborators:
Advisor: Loren Cobb. No significant collaborators related to proposed work.

Appendix B

Academic Identification

Name

Nicole A. Bannister

Position

Assistant Professor — August 2012-Present

Middle Grades Mathematics Education, Departments of Teacher Education and Mathematical Sciences, Clemson University

Academic Degrees

Doctor of Philosophy, Learning Sciences — December 2009

University of Washington — Seattle, WA

Dissertation: *Reframing Practice: High School Mathematics Teachers' Learning Through Interactions in Teacher Groups*

Committee: Dr. Ilana Horn (Chair), Dr. John Bransford, Dr. Elham Kazemi, Dr. James King

Master of Science, Mathematical Sciences — May 2001

Clemson University — Clemson, SC

Bachelor of Science, Mathematics — May 1999

College of Charleston — Charleston, SC

Minor: Secondary Mathematics Education — Honors Program Graduate

Professional Background and Licensure

Mathematical Sciences Education Outreach Coordinator and Lecturer — August 2011-July 2012
Department of Mathematical Sciences, Clemson University

AP Reader, Advanced Placement Calculus AB and BC — Summer 2010-2012
Educational Testing Service, College Board

Research Assistant, Adaptive Professional Development Project — August 2004-July 2008
Funded by a National Science Foundation, Math and Science Partnership (MSP)
College of Education, University of Washington

Secondary Mathematics Instructional Coach — August 2006-July 2008
Seattle Public Schools, Cleveland High School, Seattle, WA

High School Mathematics Teacher — August 2006-July 2007
Seattle Public Schools, Cleveland High School, Seattle WA

High School Mathematics Teacher — August 2001-July 2004
Gwinnett County Public Schools, Grayson High School, Loganville, GA

Advanced Placement Calculus Teaching Endorsement — July 2001
College Board

Graduate Teaching Assistant, Mathematical Sciences — 1999-2001
Department of Mathematical Sciences, Clemson University

National Board Teaching Certification — 2008-2018
Certification: Adolescence and Young Adulthood Mathematics (AYA/Math)

State of Washington Teaching License — 2006-2016
Certification: Mathematics (6-12)

State of Georgia Teaching License — 2000-2010
Certifications: Mathematics (6-12); Gifted-In Field

State of South Carolina Teaching License — 1999-2004
Certification: Mathematics (6-12)

Research

Selected Publications

Bannister, N. (under review). An exploration of the focal mathematics teacher video club experience. *Mathematics Teacher Educator.*

Bannister, N. (under review). A framing methodology for analyzing learning in mathematics teacher communities. *Journal for Research in Mathematics Education*.

Bannister, N. (revise/resubmit - under review). Reframing practice: Teacher learning through interactions in a collaborative group. *The Journal of the Learning Sciences*.

Bannister, N. (2011). A sweet way to investigate volume. *Mathematics Teacher, 105*(5), 400.

Bannister, N. & Linder, S. (under review). Teaching for learning: Recasting a traditionally summative assessment as an intentionally formative experience. *The Educational Forum*.

Selected Presentations

Bannister, N. (2014, July). (1) *Developing perseverance and problem solving skills in an intermediate algebra context*. (2) *Developing mathematical precision and argumentation skills in an intermediate algebra context*. Invited presentations at the National Council of Teachers of Mathematics Interactive Institute for Grades 9-12. Chicago, IL.

Bannister, N. (2014, June). *Capturing teachers' learning through their framing of a struggling student problem*. Presentation at the International Conference of the Learning Sciences. Denver, CO.

Bannister, N. (2014, April). *A brief introduction to high-press questioning.* Presentation at the National Council of Teachers of Mathematics Annual Meeting, New Orleans, LA.

Bannister, N. (2014, January). *Capturing high school mathematics teachers' learning through their framing of struggling student problem.* Presentation at the Hawaii International Conference on Education. Honolulu, HI.

Luedeman, J., Bannister, N., & Williams, C. L. (2014). *Improving middle grades teacher quality through the Clemson Mathematics Institute and Video Club*. Proceedings of the Hawaii International Conference on Education. Honolulu, HI.

Bannister, N. & Seawright, J. (2013, October). *The power of pattern blocks . . . for students and their teachers*! Presentation at the South Carolina Council of Teachers of Mathematics Annual Conference, Greenville, SC.

Bannister, N. (2012). *Constructing equitable teaching practices: An analysis of mathematics teachers' conversations*. Proceedings of the 2012 Annual Meeting of the American Educational Research Association. Vancouver, British Columbia, Canada.

Bannister, N. (2011). *Reframing failure: An analysis of high school mathematics teachers' learning*. In Wiest, L. R., & Lamberg, T. (Eds.). Proceedings of the 33rd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Reno, NV: University of Nevada, Reno.

Bannister, N. & Horn, I.S. (2009). *Re-framing failure: High school mathematics teachers' learning about struggling students*. Proceedings of the 13th Biennial Conference of the European Association for Research on Learning and Instruction. Amsterdam, The Netherlands.

Selected Honors and Awards

- Service, Teaching, and Research (STaR) Fellow, Association of Mathematics Teacher Educators, 2014-2015.
- Eugene T. Moore School of Education Excellence in Teaching Award, Clemson University. 2012-2013.
- Finalist for the Teaching and Teacher Education (Division K) Outstanding Dissertation Award, American Educational Research Association, 2010.
- Finalist for the Spencer Dissertation Fellowship, National Academy of Education, 2010.
- Microsoft Innovative Teacher Award, Microsoft Partners in Learning, 2007.
- Recognition of Excellence Award for Outstanding Performance on the Praxis II (Mathematics: Content Knowledge), Educational Testing Service, 2006.
- Most Inspiring Teacher Award, Atlanta Toyota, Nominated by High School Student Joshua Golden, 2004.
- Student/Teacher Achievement Recognition (STAR) Teacher, Gwinnett County Public Schools, Nominated by High School Student David Rutter, 2004.
- Outstanding Creativity in the Classroom Award, Grayson High School, Nominated by Grayson High School Administration, 2003.
- Georgia Intern-Fellowships for Teachers (GIFT) Fellow, Georgia Institute of Technology, 2003.

Appendix C

Phillip Michael Wilder

Education:

Ph.D., Language and Literacy, University of Illinois at Urbana-Champaign 2008-2013
Dissertation: "I Can Only Cognitively Coach So Much": Heavy Coaching Efforts Amidst Disciplinary Complexities in Secondary School Classrooms

M.A., Curriculum and Instruction, University of Illinois at Urbana-Champaign 2000-2001
Granted: 6-12 Reading Specialist Endorsement

B.A., Teaching of Social Studies, University of Illinois at Urbana-Champaign 1991-1995
Minor: English & State of Illinois Teaching Certificate; Grades 6-12

Professional Experience:

Assistant Professor of Disciplinary Literacy 2013-Present
Department of Teacher Education
Clemson University, Clemson, SC

Literacy Consultant 2013-Present
Public Consulting Group
Portsmouth, NH

Secondary Teacher Collaborator 2007-2013
Center for Education in Small Urban Communities
University of Illinois at Urbana-Champaign

Literacy Coach/English Teacher 2002-2007
Champaign Central High School, Champaign, IL

English/Social Studies Teacher 1996-2000
Joliet West High School, Joliet, Illinois

Research:

Selected Publications

Wilder, P. (2014). Coaching heavy as a disciplinary outsider: Negotiating disciplinary literacy for adolescents. *The High School Journal*, 97(3), 159-179.

Wilder, P. & Herro, D. (2014). Supporting inquiry with digital texts in school disciplines. In T. Rasinski, R. Ferdig, & K. Pytash (Eds.), Using Technology to Enhance Reading: Innovative Approaches to Literacy Instruction (p. 1-21). Bloomington, IN: Solution Tree.

Gutzmer, C. & Wilder, P. (2012). "Writing so people can hear me": Responsive teaching in a middle school poetry unit. *Voices from the Middle*, 19(3), 37-44.

Dressman, M., Wilder, P. (2007). Wireless technology and the prospect of alternative education reform. In J. Albright and A. Luke (Eds.), *Pierre Bourdieu and literacy education* (pp. 113-135). Mahwah, NJ: Lawrence Erlbaum Associates.

Wilder, P., & Dressman, M. (2006). New literacies, enduring challenges? The influence of capital on

adolescent readers' internet practices. In D. E. Alvermann, K. A. Hinchman, D. W. Moore, S. F. Phelps, & D. R. Waff (Eds.), *Reconceptualizing the literacies in adolescents' lives* (2nd ed.) (pp. 205-229). Mahwah, NJ: Lawrence Erlbaum Associates.

Dressman, M., O'Brien, D., Rodgers, T., Ivey, G., Wilder, P., Alvermann, D., Moje, E., & Leander, K. (2006). Problematizing adolescent literacies: Four instances, multiple perspectives. In 55th *National Reading Conference Yearbook*, pp. 141-154.

Dressman, M., Wilder, P. & Johnson-Connor, J. (2005). Theories of failure and the failure of theories: A cognitive/sociocultural/macro structural study of eight struggling students. *Research in the Teaching of English*, 40(1), 8-61.

Selected Refereed Conference Papers

Wilder, P. (October, 2014). Literate Disciplinary Teaching: Preparing Pre-Service Teachers for Disciplinary Literacy Instruction. Paper presented at the annual meeting of the Literacy Research Association, Marco Island, FL

Wilder, P. (October, 2014). "I won't lie to you. Chemistry makes my brain hurt:" The Influence of disciplinary expertise in secondary school instructional coaching Collaborations. Paper presented at the annual meeting of the Association of Literacy Educators and Researchers, Delray Beach, FL.

Wilder, P. (October, 2014). "Why Won't You Just Tell Us How to Teach Literacy?": Redesigning Pre Service Content Area Literacy Education for Disciplinary Literacy. Paper presented at the annual meeting of the Association of Literacy Educators and Researchers, Delray Beach, FL.

Wilder, P. (December, 2013). Coaching for Student Impact in Secondary Classrooms: The Relationship of Disciplinary Knowledge, Epistemic Beliefs and Pedagogy on Coaching Stance. Paper presented at the annual meeting of the Literacy Research Association, Dallas, TX.

Wilder, P. (December, 2012). *Coaching Heavy in Secondary Classrooms: Negotiating Learning for Adolescents.* Paper presented at the annual meeting of the Literacy Research Association, San Diego, CA.

Wilder, P. & Gutzmer, C. (May, 2011). *Responding to the literacy needs of students: Differentiating the writing experience in a 6th grade poetry unit.* Paper presented at the annual meeting of the International Reading Association, Orlando, FL.

Wilder, P., & Dressman, M. (2005). *New Literacies, Enduring Problems?: Comparing Under- and Over Capitalized Adolescent Readers' Internet Practices.* Paper presented at the annual meeting of the National Reading Conference, Miami, FL.

Dressman, M., Wilder, P., & Johnson, J. L. (2002). *Theories of failure and the failure of theories: A cognitive/sociocultural/critical study of eight struggling students.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Appendix D

JOHN K. LUEDEMAN
103 Moselle Drive
Seneca, SC 29672
864 723-9015 (H)
864 650-4599 (C)

Academic Training:
Valparaiso University, B.A. degree with distinction in Mathematics, Minors in German, Philosophy, and Physics. 1963
Southern Illinois University, M.A. degree in Mathematics. 1965
State University of New York at Buffalo, Ph.D. degree in Mathematics. 1969
Academic Positions:
Adjunct Professor of Teacher Education, Clemson University, 2004 – 2006
Professor Emeritus of Mathematical Sciences and Education, Clemson University, 2002 – present.
Program Officer, National Science Foundation (IPA), 1998-99
Professor of Education, Clemson University, 1989-2002
Director, Center of Excellence in Mathematics and Science Education
Professor of Mathematical Sciences, Clemson University, 1980 - 2002
Associate Professor of Mathematical Sciences, Clemson University, 1971 - 1980
Assistant Director of NSF Summer Institute, Rutgers, 1969
Assistant Professor of Mathematical Sciences, Clemson University, 1968 - 1971
Instructor of Mathematics, SUNY at Buffalo, 1967 - 1968
Instructor in NSF Summer Institute, Rutgers, 1967
Consulting, Service Activities, and/or Other Outside Activities:
Consultant to Oconee County School District
Consultant to the U. S. Fish and Wildlife Service.
Consultant to the South Carolina State Department of Education.
Consultant to Dunlop Golf Company.
Courses Taught: MthSc 115: Mathematics for Elementary Teachers, I;
MthSc 116: Mathematics for Elementary Teachers, II;
MthSc 216: Geometry for Elementary Teachers;
MthSc 791: Special Topics in Mathematics Education.
Various graduate mathematical science courses in topology and algebra.
Research and Creative Endeavors: I have over 60 publications in refereed journals. I have co-authored Elementary Linear Algebra with Stan Lukawecki. I have published several popular mathematics education articles in newspapers throughout the state dealing with how mathematics should be taught in the schools, exciting educational mathematics and science toys suitable for Christmas presents, and other topics. I have served as the external evaluator for several projects, the latest being the ITQ grant and CE-MIST at the University of South Carolina at Aiken as well as ITEC, RE-MAST, and RETAIN at Newberry College.
***Editorial Services*:**
Textbook reviewer for McGraw-Hill, Prentice Hall, Reston, and West Publishing Companies.

Referee for Semigroup Forum, Journal of Pure and Applied Algebra, Simon Stevrin, National Science Foundation.

Mathematics and Science Research Conference Presentations: I have given over 100 presentations at various professional conferences. I also give frequent inservice presentations on mathematics education to school teachers, parent-teacher organizations, and the public.

Activities conducted in collaboration with K-12 schools: I have completed 5 years of service on the Governor's Mathematics Science Advisory Board. I have served as vice-president for higher education of the South Carolina Council of Teachers of Mathematics and as Executive Director of the South Carolina Mathematics and Science Coalition. I am a consultant to the SC State Department of Education for the SuperStars program having developed the teacher-training portion of the program as well as assisted in developing the student materials. I am a delegate to the state Curriculum Congress. I was a founding member of the South Carolina Universities Research Education Foundation's Education Committee.

Professional Memberships: American Mathematical Society, American Statistical Association, National Council of Supervisors of Mathematics, National Council of Teachers of Mathematics, South Carolina Council of Teachers of Mathematics.

***Funded Grant/Contract/Seminar Proposals*:** I have served as principal investigator for over $18 million of funded grants. The funding has been received from the National Science Foundation, the South Carolina Commission on Higher Education, The South Carolina State Department of Education, Clemson University, the Exxon Foundation, and National Cash Register Corporation. Currently I evaluate the RETAIN Center of Excellence for Newberry College.

Recent Publications:

"Tag and Recapture in Lake Ridgeland", MathMate 20, (1996).

.Using Graduate Students in the Sciences as Middle School Content Experts. *Journal of College Science Teaching*, *XXXII,* 302-304 (2003).

.Using Graduate Students from Mathematics and the Sciences as Middle School Content Experts. In White, A. and Berlin, D., Editors. *Improving Science and Mathematics Education: Insights for a Global Community*. Columbus, OH: Ohio State University Press. (2003)

.Using Graduate Students in Mathematics and the Sciences as Middle School Content Experts. *Seventh Yearbook of the International Association for Research in Science and Mathematics Education*. Columbus, OH: Ohio State University Press. (2002)

"Predators Encountering a Model-Mimic System with Alternate Prey," (with F. R. McMorris and Daniel D. Warner), American Naturalist, 117 (1981), 1040-1048.

"Counterexamples in Measuring the Distance Between Binary Trees." Math. Social Sciences 4 (1983), 271-274 (with J. P. Jarvis and D. R. Shier).

"Comments on Computing the Similarity of Binary Trees," J. Theoretical Biology 100 (1983) 427-433 (with J. P. Jarvis and D. R. Shier).

Co-Authors and Collaborators: William Leonard, Robert Horton, John Wagner, Clemson University and Cindy Johnson and Tina McCartha at Newberry College.

Doctoral Students: Antonio M. Lopez, Loyola University of New Orleans; James Bate, Clemson University; Paula Gregg, South Carolina Commission on Higher Education.

Graduate Students: Since I am retired I have supervised no graduate student research in the past ten years.

Appendix E

Benjamin J. Sinwell
308 Big Oak Road, Anderson SC 29626
Tel: (617) 872-0606; Email: besinwell@yahoo.com

Education

Boston University, Mathematics Education, M.Ed. 2003.
Vassar College, Biology, B.A. 1999.
Boston University, semester abroad, School for Field Studies: Turks and Caicos Islands, 1998

Teaching Credential

National Board Certification, Mathematics (Early Adolescence & Young Adulthood), 2008-2018.
South Carolina Teaching License, Secondary Mathematics (Grades 8-12), valid until 2018.

Professional Experience

Mathematics Teacher, Pendleton High School, Pendleton, SC, 2009-present.
Mathematics Teacher, Northwood High School, Silver Spring, MD, 2006-2009.
Mathematics Teacher, Howard University Middle School of Mathematics and Science, Washington, DC, 2005–2006.
Mathematics Teacher, Chelsea High School, Chelsea, MA, 2001-2005.
Instructor, Institute for Advanced Study/Park City Mathematics Institute, Summer 2003-2008.
- Designed and co-taught six 30-hour advanced mathematics summer courses for teachers.

Science Teacher, Brooklyn Middle School, Long Term Substitute, Brooklyn, CT, Spring 2000.
Fishery Observer, National Marine Fisheries Service, NOAA, 2000-2001.

Publications

Sinwell, B. (2009). *Creating recursive patterns using trains*. Published in Resources for teaching discrete mathematics: classroom projects, history modules, and articles, MAA Notes.
Sinwell, B. (2008). *Using NBA statistics for box and whisker plots*. NCTM Illuminations. *http://illuminations.nctm.org/LessonDetail.aspx?id=L737*
Sinwell, B. (2008). *Fibonacci trains*. NCTM Illuminations. *http://illuminations.nctm.org/LessonDetail.aspx?id=L736*
Sinwell, B. (2008). *Counting the trains*. NCTM Illuminations. *http://illuminations.nctm.org/LessonDetail.aspx?id=U184*
Sinwell, B. (2004). Chebyshev polynomials: Patterns and derivation. *Mathematics Teacher, 98*(1): 20-25.
J. H. Long Jr, M. Koob-Emunds, B. Sinwell, and T. J. Koob. (2003). The notochord of hagfish Myxine glutinosa: visco-elastic properties and mechanical functions during steady swimming. *Journal of Experimental Biology*, *205*(24): 3819 – 3831.
Sinwell, B.J., Czuwala, P.J., Long, J.H. Jr., Koob-Emunds, M. & T.J. Koob. (1999). Bending mechanics of the hagfish (Myxine glutinosa) notochord under different osmotic treatments. *The Bulletin, Mt. Des. Is. Bio. Lab. 38.* 94-96.

Selected Presentations

Sinwell, B. (2014, 2013, 2012). Invited workshops at the NCTM Reasoning and Sense-Making Institute in High School. Chicago, IL; Orlando, FL; Los Angeles, CA.

Sinwell, B. (2011). Invited workshop: *Developing reasoning and sense-making skills in high school algebra*. NCTM Reasoning and Sense-Making Institute, Orlando, FL.
Sinwell, B. (2009). Keynote address: *The National Board for Professional Teaching Standards and the Student Evaluation Standards*. Invitational Conference on Benchmarking Teachers' Student Evaluation Practice. Alexandria, VA.
Sinwell, B. (2009). *Recursion for all: Using different methods to learn recursion*. NCTM Annual Conference. Washington, DC.
Sinwell, B. (2007). Invited presentation: *Building and sustaining communities of mathematicians and Teachers*. Special session on Mathematics and Education Reform at the AMS/MAA Joint Mathematics Meetings. New Orleans, LA
Sinwell, B and B. Kerins (2007). *Developing mathematics: A mathematics content course for teachers resulting in a proof of the fundamental theorem of algebra* at the AMS/MAA Joint Mathematics Meetings. New Orleans, LA
Sinwell, B. (2004). *Chebyshev polynomials: Patterns and derivation*. Tenth International Congress on Mathematics Education. Copenhagen, Denmark.

Professional Learning Activities

Guest lecturer, "Geometry for Secondary Teachers" course, Clemson University, Summer 2011
Editorial Panel Member for *The Mathematics Teacher*, National Council of Teachers of Mathematics, *Mathematics Teacher*, 2008-11.
Professional Development Instructor, Chelsea High School, Spring 2003-Spring 2005.
▪ Courses taught: Iteration, Graphing calcs, Pythagorean Thm and Fitting Polynomials to Data.
Education Development Center, Focus On Mathematics Grant Facilitator, 2004-2005.
▪ District liaison to the Focus on Mathematics partnership, a 5-year, $10 million grant funded by the National Science Foundation (www.focusonmath.org).
PROMYS for Teachers Participant, Boston University, Summer 2002-2009.
▪ Six-week PROMYS for Teachers summer program and presenter at PROMYS bi-monthly seminars. Education Development Center, Teacher Advisory Board for Mathematical Themes, 2003-04.
▪Mathematical Themes is a National Science Foundation funded high school mathematics curriculum.
Chelsea High School, School Improvement Plan Writer, Spring 2003.

Awards

Teacher of the Year, Northwood High School, 2008–2009.
ETS Recognition of Excellence, Praxis II, Mathematics: Content Knowledge, 2005.
Travel Award from the National Council of Teachers of Mathematics to attend the Tenth International Congress on Mathematics Education (ICME), Copenhagen, Denmark, 2004.
Attracting Excellence to Teaching Loan Forgiveness Program, Massachusetts Department of Education, 2001-2003.
Brownell Prize for Excellence in Biology, Vassar College, 1999.
Eagle Scout Award, Boy Scouts of America, 1994.

Professional Affiliations

National Council of Teachers of Mathematics, Spring 2002-present.
South Carolina Council of Teachers of Mathematics, Spring 2010-present.

References

Ball, D. L. (1997). From the general to the particular: Knowing our own students as learners of mathematics. *Mathematics Teacher, 90*(9), 732-737.

Boaler, J., & Staples, M. (2008). Creating mathematical futures through an equitable teaching Approach: The case of Railside school. *Teachers College Record, 110*(3), 608-645.

Bransford, J. D., Brown, A. L., Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school, expanded edition.* Washington, DC: National Academies Press.

Curcio, F., Gurl, T., Artzt., A. and Sultan, A. (2013). *Implementing the common core state standards through mathematical problem solving, Grades 6-8*. Reston, VA: NCTM.

Darling-Hammond, L. (2014, June 30). To close the achievement gap, we need to close the teaching gap, *The Huffington Post*. Retrieved from http://www.huffingtonpost.com/linda-darlinghammond/to-close-the-achievement_b_5542614.html

Featherstone, H., Crespo, S., Jilk, L., Oslund, J., Parks, A., and Wood, M. (2011). *Smarter together! Collaboration and equity in the elementary math classroom*. Reston, VA: NCTM.

Gutiérrez, R. (1996). Practices, beliefs and cultures of high school mathematics departments: Understanding their influence on student advancement. *Journal of Curriculum Studies, 28*(5), 495-592.

Gutiérrez, R. (2012). Context matters: How should we conceptualize equity in mathematics education? In B. Herbel-Eisenmann, J. Choppin, D. Wagner, and D. Pimm. (Eds.), *Equity in discourse for mathematics education* (pp. 17-33). New York: Springer.

Horn, I. S. (2012). *Strength in numbers: Collaborative learning in secondary mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Horn, I.S. (2005). Learning on the job: A situated account of teacher learning in high school mathematics departments. *Cognition and Instruction, 23*(2), 207-236.

Institute for Advanced Study—Park City Mathematics Institute (IAS/PCMI) (2013). Summer school teachers program. Retrieved from https://pcmi.ias.edu/program-sstp/2014

Kanold, T. (Ed.). (2012). *Common core mathematics at work in a PLC* (Grades K-2; Grades 3-5; Grades 6-8; High School; Leader's Guide). Bloomington, IN: Solution Tree Press

Lee, V. E., & Smith, J. (1996). Collective responsibility for learning and its effects on gains in achievement and engagement for early secondary school students. *American Journal of Education, 104*(2), 103-147.

Levasseur, K. & Cuoco, A. (2003). Mathematical habits of mind. In H. L. Schoen (Ed.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 27-38). Reston, VA: NCTM.

Little, J.W. (2003). Inside teacher community: Representations of classroom practice. *Teachers College Record, 105*(6), 913-945.

Lortie, D.C. (1975). *Schoolteacher*. Chicago: University of Chicago Press.

Nasir, N., Cabana, C., Shreve, B., Woodbury, E., and Louie, N. (2014). *Mathematics for equity: A framework for successful practice*. New York: Teachers College Press.

McLaughlin, M.W., & Talbert, J.E. (2001). *Professional communities and the work of high school teaching*. Chicago: University of Chicago Press.

Moses, R.P. (2001). *Radical equations: Civil rights from Mississippi to the Algebra Project*. Boston: Beacon Press.

National Council of Teachers of Mathematics (NCTM). (2014). *Principles to action: An urgent agenda for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

National Research Council (NRC). (1989). *Everybody Counts: A report to the nation on the future of mathematics education*. Washington, DC: National Academy Press.

Sagor, R. (2010). *The action research guidebook: A four-stage process for educators and school teams* (2nd Ed.). Thousand Oaks, CA: Corwin Press.

Schoenfeld, A.H. (1988). When good teaching leads to bad results: The disasters of "well taught" mathematics courses. *Educational Psychologist, 23*, 145-166.

Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher, 31*(1), 13-25.

Sherin, M. G. (2003). Using video clubs to support conversations among teachers and researchers. *Action in Teacher Education, 24*(4), 33-45.

Sherin, M. G., & Han, S. Y. (2004). Teacher learning in the context of a video club. *Teaching and Teacher Education, 20*(2), 163-183.

Sherin, M. G., & van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of Technology and Teacher Education, 13*(3), 475-491.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wiggins, G. and McTighe, J. (2005). *Understanding by design*, *Exp. 2nd Ed*. Upper Saddle River, NJ: Pearson.

Partnership Description and Cooperative Planning

COLLABORATIVE PLANNING EFFORTS		
Date	**Personnel**	**Purpose/Topic**
Ongoing	Dr. Calvin L. Williams Dr. Nicole Bannister Dr. Phil Wilder Dr. John Luedeman	Frequent email communication and in-person meetings about the project. Any communications with the LEAs are shared across the project team. All written documents (e.g., proposal, budget) are written jointly and revised using team feedback.
7/24/14	Dr. Calvin L. Williams Dr. Nicole Bannister	Meeting about our ideas for a future project.
8/4/14	Dr. Calvin L. Williams Dr. Nicole Bannister Mr. Ben Sinwell Dr. John Luedeman	Email communication about the results of the post-assessment from the summer institute program.
8/19/14	Dr. Nicole Bannister Dr. Phil Wilder	Meeting to brainstorm project ideas in context of our previous work.
9/12/14	Dr. Nicole Bannister Dr. Phil Wilder	Required technical assistance training with Dr. Paula Gregg and Dr. Rachel Harvey.
9/12/14, 9/15/14, 9/18/14	Dr. Nicole Bannister Dr. Julie Fowler	Email communication with Dr. Julie Fowler, Assistant Superintendent for Greenwood 51 (Ware Shoals) to schedule a project meeting.
9/12/14, 9/15/14, 9/18/14	Dr. Nicole Bannister Ms. Jean Smith	Email communication with Ms. Jean Smith, Director Instruction for Abbeville County to schedule a project meeting.
9/15/14	Dr. Nicole Bannister Dr. Phil Wilder	Meeting to write and implement a teacher needs assessment and to discuss a writing schedule for our proposal.
9/29/14	Dr. Nicole Bannister Dr. Phil Wilder Dr. Julie Fowler Dr. Faye Sprouse	Meeting with Dr. Fowler and Dr. Sprouse (Superintendent) to give reports on our prior work, determine partnership interest, and discuss Ware Shoals teachers' needs. Dr. Fowler re-emphasized a need for our project to address teachers making sense of student data and aligning teachers' curriculum, instruction, and assessment. Dr. Bannister will share a copy of the proposal with Dr. Fowler and Dr. Sprouse for their approval.
9/29/14	Dr. Nicole Bannister Dr. Phil Wilder Ms. Jean Smith	Meeting with Jean Smith to give reports on our prior work, determine partnership interest, and discuss Abbeville County teachers' needs. Ms. Smith emphasized a need for our project to address the changing mathematics standards and policies in South Carolina. Ms. Smith offered the use of district facilities for our work. Dr. Bannister will share a copy of the proposal with Ms. Smith for her approval.

Management Plan

PROPOSED PROJECT TIMELINE **Improving Teacher Quality** **Higher Education Grant Program** **Project Year 2015-2016**				
Objective	**Activities**	**Personnel**	**Start Date**	**End Date**
	Recruit Middle Level (5-10) Mathematics Teachers	Dr. Nicole Bannister, Dr. Calvin L. Williams, Dr. Phil Wilder	01/2015	05/2015
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Video Club	Dr. Calvin L. Williams, Dr. Nicole Bannister, Dr. Phil Wilder	04/2015	06/2015
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Classroom Observations and Teacher Meetings	Dr. Nicole Bannister, Dr. Phil Wilder	04/2015	06/2015
Improve Mathematics Content Knowledge	Clemson Mathematics Summer Institute	Dr. Calvin L. Williams, Dr. Nicole Bannister	06/2015	07/2015
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Clemson Mathematics Summer Institute	Dr. Nicole Bannister, Dr. Phil Wilder	07/2015	07/2015
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Video Club	Dr. Calvin L. Williams, Dr. Nicole Bannister, Dr. Phil Wilder	09/2015	06/2016
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Classroom Observations and Teacher Meetings	Dr. Nicole Bannister, Dr. Phil Wilder	09/2015	06/2016
Improve Mathematics Content Knowledge	Clemson Mathematics Summer Institute	Dr. Calvin L. Williams, Mr. Ben Sinwell Dr. Nicole Bannister	06/2016	07/2016
Improve Mathematics Content Knowledge and Pedagogical Content Knowledge	Clemson Mathematics Summer Institute	Dr. Nicole Bannister, Dr. Phil Wilder	06/2016	07/2016

Program Structure and Responsibilities

The *Understanding Mathematics by Design* project centers on a series of two summer institutes and a video club program throughout the academic year. All activity development – mathematics content and mathematics methods – will be conducted as a collaborative effort between the Clemson University Mathematical Sciences department and Teacher Education. A local Master Teacher will be included in the development of the summer institute mathematics program. Experts in the area of curriculum development, technology, and meeting the needs of diverse populations will be consulted as needed. Activities will be developed during the academic year. The hallmark feature of our project is how we integrate mathematics content and pedagogical content knowledge; as such, teachers will necessarily work on content and methods concepts concurrently. The project director, Dr. Calvin L. Williams, and the project co-director, Dr. Nicole Bannister will assume primary responsibility for facilitating the mathematics content programs. Mr. Benjamin Sinwell, a local Master Teacher, will assume secondary responsibility for teaching the summer institute mathematics program in the summer of 2016. The project co-director, Dr. Nicole Bannister, and Dr. Phil Wilder will assume primary responsibility for facilitating Video Club and portions of the summer institute related to developing pedagogical content knowledge. A Clemson University graduate student will be assigned to Dr. Bannister from the Teacher Education department and will assist the project leadership team with data management and program preparation. Abbeville County School District will make facilities available for the summer institutes and academic year course work, and if needed, Greenwood 51 will host our programs. Dr. John Luedeman will act as external evaluator for the grant.

Dissemination

Clemson University faculty and teacher participants will disseminate outcomes from the *Understanding Mathematics by Design* project through national and state conference presentations. Teachers and Clemson University faculty will also prepare manuscripts for submission to peer-reviewed research journals and practitioner journals that are of interest to middle level mathematics teachers.

BUDGET REQUEST
IMPROVING TEACHER QUALITY
Higher Education Grants Program
Project Year: 2015-2016

INSTITUTION: Clemson University	*Partner* E = Education A = Arts & Sciences HN = High Needs LEA L = LEA	Proposed Budget	Institutional Funds	Other Funds (school district, grants, private, etc.)	CHE use
PROJECT DIRECTOR: Dr. Calvin L. Williams					
1. Key Personnel (Faculty/Administration) LIST NAMES & Role					
A. Salaries					
1 Dr. Calvin L. Williams	A	9000			
2 Dr. Nicole Bannister Sinwell	E	14000			
3 Dr. Phil Wilder	E	7000			
Total Key Personnel Salaries		30000	0	0	
B. Fringe Benefits TOTAL					
1 Dr. Calvin L. Williams	A	2538			
2 Dr. Nicole Bannister Sinwell	E	3948			
3 Dr. Phil Wilder	E	1974			
Total Key Personnel Fringe		8460	0	0	
TOTAL KEY PERSONNEL COSTS		38460	0	0	
2. Support Personnel (LIST NAMES)					
A. Salaries					
1 Clemson PhD Graduate Student Stipend	E	21000			
Total Support Personnel Salaries		**21000**	**0**	**0**	
B. Fringe Benefits TOTAL					
1 Clemson PhD Graduate Student Stipend	E	1113			
Total Support Personnel Fringe		1113	0	0	
Total SUPPORT PERSONNEL COSTS		22113	0	0	
TOTAL PERSONNEL COSTS		**60573**	**0**	**0**	
3. Participant Support (District/School participants)					
a. Books					
Abbeville	HN	1800			
Greenwood 51 (Ware Shoals)	HN	450			
b. Supplies and Materials					
Abbeville	HN	1000			
Greenwood 51 (Ware Shoals)	HN	250			
c. Travel and Subsistence					
Abbeville	HN	900			
Greenwood 51 (Ware Shoals)	HN	400			
d. Room and Board					
Abbeville	HN	800			
Greenwood 51 (Ware Shoals)	HN	400			

e. Stipends					
Abbeville	HN	50000			
Greenwood 51 (Ware Shoals)	HN	12500			
f. Tuition					
g. Technology/Equipment					
h. Other - PLEASE SPECIFY					
Total Participant Costs		68500	0	0	
4. Supplies and Materials (Institution - break down by Education and Arts & Sciences) LIST MAJOR ITEMS					
a.					
Total Supply Costs		0	0	0	
5. Equipment/Technology (greater than $5,000 per item)					
a.					
Total Equipment Costs		**0**	**0**	**0**	
6. Additional Costs - PLEASE SPECIFY (includes contract services)					
a. External Evaluator: Dr. John K. Luedeman	A	8000			
b. Master Teacher: Mr. Ben Sinwell	A	1000			
Total Additional Costs		**9000**	**0**	**0**	
7. Travel and Subsistence					
a. Education (State Employee)	E	5140			
b. Education (Non-state employee)					
c. Arts & Sciences (State Employee)	A	749.96			
d. Arts & Sciences (Non-State Employee)					
Total Other Travel		**5889.96**	**0**	**0**	
Total Direct Costs		143962.96	0	0	
Indirect Costs (8% * (direct costs - participant support - equipment)		6037.0368			
TOTAL PROJECT COSTS		$150,000.00	0	0	

Project Director(s) Dr. Calvin L. Williams, Coordinator of Instruction & Associate Professor of Mathematical Sciences; Director, Center of Excellence in Mathematics and Sciences Education	Typed Name & Title Signature Calvin L. Williams Date 10/14/14
Institutional Authority Dr. Larry Dooley, Vice President for Research	Typed Name & Title Signature Date 10/14/14

Signing for

Budget Justification

1. Key Personnel

Dr. Calvin L. Williams will serve as Project Director and Dr. Nicole Bannister will serve as co-director. Dr. Williams' salary is $9,000 (fringe is $2,538), which represents his time and effort in administering and managing the grant as well as in program development and implementation of program activities, with focus on the content development and implementation for the summer institute programs. Dr. Bannister's salary is $14,000 (fringe is $3,948), which represents her time and effort in administering and managing the grant as well as in program development and implementation of all aspects of all program activities. Dr. Bannister also maintains primary responsibility for outreach and communication with teachers and districts. Dr. Wilder's salary is $8,000 (fringe is $1,974), which represents his time and effort in developing and implementing program activities, with focus on activities related to training in formative assessment, backwards planning, and action research.

2. Participant Costs

Textbooks are budgeted at $90 per teacher for 25 teachers. Supplies and materials are budgeted at $50 per teacher for 25 teachers. Travel funds will be used to partially support participating teachers' attendance at regional or national mathematics teachers conferences such as SCCTM or NCTM ($200 per teacher for 12 teachers). Stipends are budgeted at $2500 per teacher for 25 teachers. Stipends are based on attendance and participating fully in all or most of our program activities. Stipends will be awarded in stages as appropriate (e.g., up to $825 stipend (x2) for summer institute participation; up to $850 stipend for video club participation).

3. Additional Costs

The budget for the external evaluator, Dr. John K. Luedeman, is $8,000. The budget for the Master Teacher, Mr. Benjamin Sinwell, is $1000 for the content portion of the 2016 summer institute. Given the increased expectations for program evaluation, our team budgeted for graduate student assistance with the management of data and program preparation. The budget for a graduate student stipend is $21,000. The graduate student will be assigned to Dr. Bannister for 20 hours per week, who will supervise the GA's work and check timesheets. The graduate student will be responsible for assisting team leaders with data collection, data management, data analysis, dissemination activities, and the preparation of program activities.

4. Travel and Subsistence

Our program activities are located more than an hour away from Clemson University and faculty homes. Since we hold our program activities on site for participating teachers, we budgeted $2000 per faculty member for travel related to the grant, including required attendance at meetings, travel for program implementation, and travel for dissemination of findings related to grant activities at state and national conferences. We also budgeted $2000 for mileage reimbursement for our assigned graduate student, as long-distance travel for data collection and program preparation is beyond the regular call of duty for Clemson graduate students.

PARTNERSHIP AGREEMENT

South Carolina Commission on Higher Education
Improving Teacher Quality Higher Education Grants Program

This cooperative agreement reflects the overall commitment as well as the specific responsibilities and roles of each of the partners participating in the proposed *Improving Teacher Quality Higher Education Grants Program*. A copy of this form must be completed for each member of the partnership (at a minimum, the lead institution, school of education, division of arts and sciences, and a high need LEA).

Clemson University, Mathematical Sciences Agrees to make the following contributions or play the following roles in the project.

(Name of Organization)

1. Support grant activities by administering and managing the grant.
2. Support grant activities by generating and implementing content for the content-focused activities.
3. Support grant activities by generating and implementing content for the pedagogical content knowledge-focused activities.

The organization assures that this proposal addresses the following professional development need(s) identified by the high-need LEA's needs assessment:

1. Development of teachers' content knowledge related to the middle grades mathematics standards for South Carolina.
2. Help teachers make sense of student data and apply these findings to individual students.
3. Help teachers align their curriculum, instruction, and assessment practices.

The organization further assures that this proposal was developed with input from the following higher education and high-need LEA faculty and or staff:

Lead Contact Name **Dr. Calvin L. Williams**

Signature Calvin L. Williams

Date 10/13/14

Signature of Dean (if IHE)

PARTNERSHIP AGREEMENT

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Clemson University, Teacher Education Agrees to make the following contributions or play the following roles in the project.

(Name of Organization)

1. Support grant activities by administering and managing the grant.
2. Support grant activities by generating and implementing content for the content-focused activities.
3. Support grant activities by generating and implementing content for the pedagogical content knowledge-focused activities.

The organization assures that this proposal addresses the following professional development need(s) identified by the high-need LEA's needs assessment:

1. Development of teachers' content knowledge related to the middle grades mathematics standards for South Carolina.
2. Help teachers make sense of student data and apply these findings to individual students.
3. Help teachers align their curriculum, instruction, and assessment practices.

The organization further assures that this proposal was developed with input from the following higher education and high-need LEA faculty and or staff:

Lead Contact Name **Dr. Nicole Bannister**

Signature Nicole Bannister (Sinwell)

Date 10-9-14

Signature of Dean (if IHE)

PARTNERSHIP AGREEMENT

South Carolina Commission on Higher Education
Improving Teacher Quality Higher Education Grants Program

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Abbeville County School District Agrees to make the following contributions or play the following roles in the project.

(Name of Organization)

1. Provide facilities for summer institute and video club program meetings.
2. Support teacher participation in dissemination activities, such as attending a mathematics teacher conference.
3. Provide food for 30 participants for four video club meetings.

The organization assures that this proposal addresses the following professional development need(s) identified by the high-need LEA's needs assessment:

1. Development of teachers' content knowledge related to the middle grades mathematics standards for South Carolina.
2. Help teachers make sense of student data and apply these findings to individual students.
3. Help teachers align their curriculum, instruction, and assessment practices.

The organization further assures that this proposal was developed with input from the following higher education and high-need LEA faculty and or staff:

Lead Contact Name **Ms. Jean Smith**

Signature Jean Smith

Date 10/13/2014

Signature of Superintendent (if School District) J. L. Phipps

PARTNERSHIP AGREEMENT

South Carolina Commission on Higher Education
Improving Teacher Quality Higher Education Grants Program

This cooperative agreement reflects the overall commitment as well as the specific responsibilities and roles of each of the partners participating in the proposed *Improving Teacher Quality Higher Education Grants Program*. A copy of this form must be completed for each member of the partnership (at a minimum, the lead institution, school of education, division of arts and sciences, and a high need LEA).

Greenwood 51 (Ware Shoals) School District Agrees to make the following contributions or play the following roles in the project.
(Name of Organization)

1. Provide facilities for summer institute and video club program meetings.
2. Support teacher participation in dissemination activities, such as attending a mathematics teacher conference.
3. Provide food for 30 participants for video club meetings.

The organization assures that this proposal addresses the following professional development need(s) identified by the high-need LEA's needs assessment:

1. Development of teachers' content knowledge related to the middle grades mathematics standards for South Carolina.
2. Help teachers make sense of student data and apply these findings to individual students.
3. Help teachers align their curriculum, instruction, and assessment practices.

The organization further assures that this proposal was developed with input from the following higher education and high-need LEA faculty and or staff:

Lead Contact Name **Dr. Julie Fowler**

Signature Dr. Julie Fowler

Date 10-14-14

Signature of Superintendent (if School District) Fay Sprouse

STATEMENT OF ASSURANCES

Improving Teacher Quality
Higher Education Grant Program
Project Year 2015-16

Clemson University

_____NAME OF INSTITUTION OR ORGANIZATION

hereby provides assurance to the South Carolina Commission on Higher Education that if this institution receives a grant under the terms of *The No Child Left Behind Act of 2001 (PL107-110); Title II Part A Teacher and Principal Training and Recruiting Fund* that it will comply with the regulations, policies, guidelines, and requirements as they relate to the application, acceptance, and use of funds for this federally funded project. Also, the applicant institution assures and certifies that it:

1. Possesses legal authority to apply for the grant.

2. Will keep such records and provide such information as may be necessary for fiscal and program auditing and for program evaluation and will provide the South Carolina Commission on Higher Education or its designee any information it may need to carry out its responsibilities under the Improving Teacher Quality Program.

3. Complies with all provisions of the Program Improving Teacher Quality and its implementing regulations and all administrative rules of the S.C. Commission on Higher Education applicable to the Improving Teacher Quality Program.

4. Enters into formalized agreement(s) with the local education agency (LEA) or consortium of LEAs in the area of proposed service.

5. Takes into account the needs of teachers and students in areas of high concentrations of low-income students and/or low-performing schools and high-need districts.

6. Will comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d) prohibiting employment discrimination where discriminatory practices will result in unequal treatment of persons who are or should be benefiting from the grant-aided activity.

Dr. Larry Dooley, Vice President for Research

Signing for

_____
Name Chief Executive Officer

_____
Signature

10-14-14
_____
Date